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Proposed Re-evaluation Decision

Copper Pesticides

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Table of Contents

Overview 1
- What Is the Proposed Re-evaluation Decision? 1
- What Does Health Canada Consider When Making a Re-evaluation Decision? 2
- What Are Copper-Containing Pesticides? 2
- What Is Copper? 3
- Health Considerations 3
- Environmental Considerations 4
- Measures to Minimize Risk 5
- Next Steps 5

Science Evaluation 7

1.0 Introduction 7

2.0 The Technical Grade Active Ingredient, Its Properties and Uses 8
- 2.1 Identity of the Technical Grade Active Ingredients 8
- 2.2 Physical and Chemical Properties of the Technical Grade Active Ingredient 8
- 2.3 Comparison of Use Patterns in Canada and the United States 9

3.0 Impact on Human Health and the Environment 10
- 3.1 Human Health 10
  - 3.1.1 Occupational Exposure and Risk Assessment 11
  - 3.1.2 Non-Occupational Exposure and Risk Assessment 12
  - 3.1.3 Cumulative Effects 13
- 3.2 Environment 13
  - 3.2.1 Environmental Risk Assessment 13
  - 3.2.2 Toxic Substances Management Policy Considerations 19

4.0 Proposed Re-evaluation Decision 20

5.0 Supporting Documentation 20

List of Abbreviations 21

Appendix I Registered Products Containing Copper Pesticides as of August 2008 23

Appendix II Label Amendments for Products Containing Copper 31

Appendix III Inputs to Buffer Zone Models 39

Appendix IV Recommended Use Details from Appendix A of 2006 USEPA RED 43

Overview

What Is the Proposed Re-evaluation Decision?

After a re-evaluation of copper-containing pesticides, Health Canada's Pest Management Regulatory Agency (PMRA), under the authority of the *Pest Control Products Act* and Regulations, is proposing continued registration of pesticides containing the following copper-based active ingredients: cuprous oxide, cupric oxide, copper sulphate, copper sulfate pentahydrate, copper oxychloride, copper hydroxide and metallic copper. Note that copper naphthenate will be re-evaluated separately. The antisapstain uses (worker exposure only) of copper 8-quinolinolate were previously assessed by the PMRA (RRD2004-08) and other antimicrobial uses of copper 8-quinolinolate will be re-evaluated in a future document.

An evaluation of the available scientific information found that pesticides containing the types of copper re-evaluated for this decision do not present unacceptable risks to human health or the environment when used according to label directions. Future reviews by the United States Environmental Protection Agency (USEPA) and the PMRA will assess the environmental impact of the antimicrobial uses of copper. As a condition of the continued registration of copper uses, new risk-reduction measures are proposed for labels of all products. No additional data are being requested at this time.

This proposal affects all end-use products containing the above-mentioned copper compounds registered in Canada. Once the final re-evaluation decision is made, the registrants will be instructed on how to address any new requirements.

This Proposed Re-evaluation Decision is a consultation document[1] that summarizes the science evaluation for copper containing pesticides and presents the reasons for the proposed re-evaluation decision. It also proposes additional risk-reduction measures to further protect human health and the environment.

The information is presented in two parts. The Overview describes the regulatory process and key points of the evaluation, while the Science Evaluation provides detailed technical information on the assessment of copper.

The PMRA will accept written comments on this proposal up to 45 days from the date of publication of this document. Please forward all comments to Publications (please see contact information indicated on the cover page of this document).

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[1] "Consultation statement" as required by subsection 28(2) of the *Pest Control Products Act*.

What Does Health Canada Consider When Making a Re-evaluation Decision?

The PMRA's pesticide re-evaluation program considers the potential risks as well as value of pesticide products to ensure they meet modern standards established to protect human health and the environment. Regulatory Directive DIR2001-03, *PMRA Re-evaluation Program*, presents the details of the re-evaluation activities and program structure.

The copper moiety of seven copper-containing pesticides that are active ingredients in the current re-evaluation cycle has been re-evaluated under Re-evaluation Program 1. This program relies as much as possible on foreign reviews, typically United States Environmental Protection Agency (USEPA) Reregistration Eligibility Decision (RED) documents. For products to be re-evaluated under Program 1, the foreign review must meet the following conditions:

- it covers the main science areas, such as human health and the environment, that are necessary for Canadian re-evaluation decisions;
- it addresses the active ingredient and the main formulation types registered in Canada; and
- it is relevant to registered Canadian uses.

Given the outcome of foreign reviews and a review of the chemistry of Canadian products, the PMRA will propose a re-evaluation decision and appropriate risk-reduction measures for Canadian uses of an active ingredient. In this decision, the PMRA takes into account the Canadian use pattern and issues (e.g. the federal Toxic Substances Management Policy [TSMP]).

Based on the health and environmental risk assessments published in the 2006 RED, the USEPA concluded that copper-containing pesticides were eligible for reregistration provided risk-reduction measures were adopted. The PMRA compared the American and Canadian use patterns and found the USEPA assessments described in this RED were an adequate basis for the proposed Canadian re-evaluation decision.

For more details on the information presented in this overview, please refer to the Science Evaluation of this consultation document.

What Are Copper-Containing Pesticides?

Nine pesticidal active ingredients in Canada containing copper are included in this review. Five of these pesticides are used in agriculture: cuprous oxide, copper sulfate pentahydrate, copper oxychloride, copper hydroxide and copper sulphate. An additional four pesticides have only antimicrobial uses: copper naphthenate, copper 8-quinolinolate, metallic copper powder and cupric oxide. As mentioned above, copper napthenate and copper 8-quinolinolate will be evaluated separately.

Copper-containing pesticides are formulated using various forms of copper, which ultimately dissociates into the cupric ion, the active component.

Pesticides containing copper are registered as broad spectrum fungicides, bactericides, aquatic herbicides, algaecides and molluscicides for use on a variety of agricultural crops and ornamentals, in forestry and in industrial processes. Copper is also added directly to water to control algae and bacterial growth.

What Is Copper?

Copper is a naturally occurring, ubiquitous element in the environment. Copper is found in water and air and occurs naturally in various foods including organ meats, seafood, beans, nuts and whole grains. In most foods, copper is bound to macromolecules rather than remaining as a free ion. For many animals, copper is essential for the homeostasis of life. The role of copper in maintaining normal health both in humans and animals has been recognized for many years. Copper is an essential cofactor for approximately a dozen copper-binding proteins for the proper regulation of copper homeostasis in humans. A deficiency of copper or a defect in copper-carrying proteins may result in symptoms such as anaemia, defective blood vessel development, growth retardation, a compromised immune function or connective tissue symptoms.

Health Considerations

Can Approved Uses of Copper Affect Human Health?

Copper is unlikely to affect your health when used according to the revised label directions.

People could potentially be exposed to pesticides containing copper by consuming food and water, by working as a mixer/loader/applicator or by entering treated sites. The PMRA considers two key factors when assessing health risks: the levels at which no health effects occur and the levels to which people may be exposed. The dose levels used to assess risks are established to protect the most sensitive human population (e.g. children and nursing mothers). Only uses for which exposure is well below levels that cause no effects in animal testing are considered acceptable for continued registration.

The USEPA concluded that copper-containing pesticides were unlikely to affect human health provided that risk-reduction measures were implemented. These conclusions apply to the Canadian situation, and equivalent risk-reduction measures are proposed.

Maximum Residue Limits

The *Food and Drugs Act* prohibits the sale of food containing a pesticide residue that exceeds the established maximum residue limit (MRL). Pesticide MRLs are established for *Food and Drugs Act* purposes through the evaluation of scientific data under the *Pest Control Products Act*. Each MRL value defines the maximum concentration in parts per million (ppm) of a pesticide allowed in/on certain foods. Food containing a pesticide residue that does not exceed the established MRL does not pose an unacceptable health risk.

Copper is currently registered in Canada for use on many fruits, vegetables and nuts and could be used in other countries on crops that are imported into Canada. Canada has a 50 ppm MRL for fresh fruits and vegetables. Where no specific MRL has been established (i.e. nuts), a default MRL of 0.1 ppm applies, which means that pesticide residues in a food commodity must not exceed 0.1 ppm. However, changes to this general MRL may be implemented in the future, as indicated in the Discussion Document DIS2006-01, *Revocation of the 0.1 ppm as a General Maximum Residue Limit for Food Pesticide Residues [Regulation B.15.002(1)]*. If and when the general MRL is revoked, a transition strategy will be established to allow permanent MRLs to be set.

Environmental Considerations

What Happens When Copper Is Introduced Into the Environment?

Copper is unlikely to affect non-target organisms when used according to the revised label directions.

Non-target organisms (e.g. birds, mammals, insects, aquatic organisms and terrestrial plants) could be exposed to copper in the environment. Environmental risk is assessed by the risk quotient method—the ratio of the estimated environmental concentration to the relevant effects endpoint of concern. The resulting risk quotients are compared to corresponding levels of concern. A risk quotient less than the level of concern is considered a negligible risk to non-target organisms, whereas a risk quotient greater than the level of concern indicates some degree of risk.

The USEPA concluded that the reregistration of copper-containing pesticides was acceptable provided risk-reduction measures to further protect the environment were implemented. These conclusions apply to the Canadian situation, and equivalent risk-reduction measures are proposed. Furthermore, the PMRA is proposing aquatic and terrestrial buffer zones for agricultural uses to protect sensitive aquatic organisms and terrestrial plants from spray drift.

Measures to Minimize Risk

The labels of registered pesticide products include specific instructions for use. Directions include risk-reduction measures to protect human and environmental health. These directions must be followed by law. As a result of the re-evaluation of copper-containing pesticides, the PMRA is proposing further risk-reduction measures for product labels.

Human Health

- Additional advisory label statements
- Additional protective equipment to protect mixers/loaders/applicators
- A restricted-entry interval to protect workers re-entering treated sites

Environment

- Additional advisory label statements
- Buffer zones to protect non-target, sensitive aquatic and terrestrial habitats

Next Steps

Before making a final re-evaluation decision on copper-containing pesticides, the PMRA will consider all comments received from the public in response to this consultation document. The PMRA will then publish a Re-evaluation Decision[2] that will include the decision, the reasons for it, a summary of comments received on the proposed decision and the PMRA's response to these comments.

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[2] "Decision statement" as required by subsection 28(5) of the *Pest Control Products Act*.

Science Evaluation

1.0 Introduction

There are nine pesticidal active ingredients in Canada containing copper. The use of five of these pesticides involves agricultural use: cuprous oxide, copper sulfate pentahydrate, copper oxychloride, copper hydroxide and copper sulphate. An additional four pesticides have only antimicrobial uses: copper naphthenate, copper 8-quinolinolate, metallic copper powder and cupric oxide. The products containing copper are registered as broad-spectrum fungicides, algaecides, aquatic herbicides, molluscicides and antimicrobials. Note that copper naphthenate will be re-evaluated separately. The antisapstain uses (worker exposure only) of copper 8-quinolinolate were previously assessed (RRD2004-08) and other antimicrobial uses of copper 8-quinolinolate will be re-evaluated in the future.

The cupric ion is the toxic component of the various copper compounds. With fungal and algae organisms, the cupric ion binds to various groups including sulfidal groups, imidazoles, carboxyls and phosphate (thiol) groups that result in non-specific denaturing of proteins, leading to cell leakage. In mollusks, copper disrupts peroxidase enzymes and affects the functioning of the surface epithelia.

Following the re-evaluation announcement for copper-containing pesticides, the registrants of technical grade active ingredients in Canada indicated they intended to provide continued support for all uses included on the labels of commercial and domestic class end-use products in Canada.

The PMRA used a recent assessment (July 2006) of copper-containing pesticides evaluated by the USEPA. This USEPA RED document included environmental and health assessments of the copper moiety for agricultural, home garden and direct water applications of the copper-containing pesticides. In addition, the human health assessment of the RED addressed cupric ion sources from the other antimicrobial applications of pesticides containing copper. An ecological assessment of antimicrobial applications of pesticides containing copper will be reviewed in a later document. Future assessments are also anticipated for the non-copper moiety of copper naphthenate and copper 8-quinolinolate. The RED for copper-containing pesticides, dated July 2006, as well as other information on the regulatory status of these pesticides in the United States can be found on the USEPA Pesticide Registration Status page at www.epa.gov/pesticides/reregistration/status.htm.

2.0 The Technical Grade Active Ingredient, Its Properties and Uses

2.1 Identity of the Technical Grade Active Ingredients

Chemical Name	Common Name	CAS #	Molecular Formula	Molecular weight	Percent Copper
Cuprous oxide	Cuprous oxide	1317-39-1	Cu_2O	143.1	96
Copper Sulfate pentahydrate	Copper sulfate pentahydrate	7758-99-8	$CuH_{10}O_9S$	249.7	25.1–25.5
Copper oxychloride	Copper oxychloride	1332-40-7	$Cl_2Cu_4H_6O_6$	427.1	56.0–59.74
Cupric hydroxide	Copper hydroxide	20427-59-2	CuO_2H_2	97.6	55.6–62.83
Copper sulphate	Basic copper sulfate	7758-98-7	$3Cu(OH)_2 \cdot CuSO_4$	468.29	54.2
Metallic copper powder		7440-50-8	Cu	63.5	69.13–100
Cupric oxide		1344-70-3	CuO	79.55	75.18–99.40

Elemental copper (cupric ion) in copper-containing pesticides is the component of toxicological interest and, as it is not degraded, there are no other degradates/metabolites of concern.

Based on a review of the available chemistry information, the technical product is not expected to contain impurities of toxicological concern as identified in Regulatory Directive DIR98-04 or TSMP Track 1 substances as identified in Regulatory Directive DIR99-03, Appendix II.

2.2 Physical and Chemical Properties of the Technical Grade Active Ingredient

Chemical Name	Vapour Pressure	Ultraviolet (UV)/Visible Spectrum	Solubility in Water	*n*-Octanol–Water Partition Coefficient	Dissociation Constant
Cuprous oxide	Negligible	Not expected to absorb at λ>300 nm	Practically insoluble	Insoluble in either octanol or water	Does not dissociate in water
Copper sulfate pentahydrate	Non-volatile	Not applicable (copper sulfate is not susceptible to photochemcial degradation	148 g/kg (0°C)	Not applicable	Dissociates completely (salt)
Copper oxychloride	Negligible at 20°C	Not provided	<10–5 mg/L	Not provided	Not provided
Cupric hydroxide	Not applicable	Not applicable	2.9 mg/L	Not applicable	Not applicable

Chemical Name	Vapour Pressure	Ultraviolet (UV)/Visible Spectrum	Solubility in Water	*n*-Octanol–Water Partition Coefficient	Dissociation Constant
Copper sulphate	Not available	Not available	Not available	Not available	Not available
Metallic copper powder	O kPa	Not expected to absorb at Y>300 nm	1 mg/L	8×10^{-7}	Not applicable
Cupric oxide	Not applicable—product is an inorganic oxide	Not applicable–copper oxide is not susceptible to photochemical degradation	0.729 ppm	Not applicable—product is an inorganic oxide	Not applicable—product is an inorganic oxide

2.3 Comparison of Use Patterns in Canada and the United States

Currently registered products containing copper in Canada are listed in Appendix I. There are 22 technical class, 72 commercial class and 59 domestic class products used in a variety of use sites.

The agricultural and ornamental use of copper-containing pesticides includes the control of diseases such as black rot, dead arm, downy mildew, leaf spot, anthracnose, cercospora leaf spot, early blight, fire blight, late blight, coryneum blight, bacterial blight, leaf mold, bacterial wilt, Alternaria and Septoria leaf spot. The direct water applications control algae and bacteria in industrial and farm ponds. In Canada, they are also used as a root growth regulator in potted nursery trees.

In agriculture, copper-containing pesticides may be applied as a single application or up to every 7 to 10 days during the growing season. The end-use products may be formulated as dusts, liquid concentrate, dry flowable, wettable powder (including water soluble packets), granule, water-dispersible granule, powder, ready-to-use liquid and solid.

As the copper-containing pesticides are used to control a great variety of pests on virtually all food and feed crops, practically all methods of application are possible (e.g. airblast, groundboom, rights-of-way equipment, mechanical duster, low and high-pressure handwand sprayer, handgun sprayer, push-type spreader, dips, drip system, hose-end sprayer and automatic metering system).

Agricultural label directions in the United States and Canada are often incomplete with respect to quantity, frequency and method of application. The USEPA conducted their environmental assessments of terrestrial uses based on the maximum label rates as well as the "highest average rate" found in the results from the user survey for orchards (apples, 4.3 kg a.i./ha) and row crops (potatoes, 0.9 kg a.i./ha). The PMRA is proposing adoption of the American application instructions.

The only forestry use of copper in Canada is for chemical pruning of roots of seedlings in pots, which is considered to result in minimal environmental exposure.

In Canada, direct application of copper to water for control of algae is allowed at 0.5–1 ppm. Application methods for direct aquatic applications of copper include broadcast dry, broadcast spray, dragging, injection (flowing water), slug or dump, or spot spray. The United States allows similar application methods at higher rates for the control of snails and tadpole shrimp. Canada also allows "pit" applications of copper for the pre-treatment of sludge at 0.5–1.0 ppm.

Based on this comparison of use patterns and methods of application it was concluded that the USEPA RED for copper is an adequate basis for the re-evaluation of Canadian agricultural, home garden, root growth regulator and direct water application uses of copper containing pesticides.

3.0 Impact on Human Health and the Environment

In its July 2006 RED, the USEPA concluded that the end-use products formulated with the following copper-containing active ingredients met the safety standard under the American *Food Quality Protection Act* and would not pose unreasonable risks or adverse effects to humans and the environment if used according to the amended product labels: copper sulfate, copper sulfate pentahydrate, copper hydroxide and copper oxychloride. Similarly, the human health assessment indicated that the non-agricultural uses of copper-containing pesticides would not pose unreasonable risks or adverse effects to humans when used according to amended directions on product labels. As indicated earlier, the PMRA's environmental assessments of antimicrobial uses of copper-containing pesticides will follow in the future.

3.1 Human Health

Toxicology studies in laboratory animals describe potential health effects resulting from various levels of exposure to a chemical and identify dose levels at which no effects are observed. Unless there is evidence to the contrary, it is assumed that effects observed in animals are relevant to humans and that humans are more sensitive to effects of a chemical than the most sensitive animal species.

Copper is a naturally occurring, ubiquitous element in the environment being present in water, air and occurs naturally in various foods including organ meats, seafood, beans, nuts and whole grains. In most foods, copper is bound to macromolecules rather than as a free ion. The role of copper in maintaining normal health both in humans and animals has been recognized for many years.

In Canada, exposure to copper-containing pesticides may occur through consumption of food and water, through residential exposure, while working as a mixer/loader/applicator or by entering treated sites. When assessing health risks, the PMRA considers two key factors: the levels at which no health effects occur and the levels to which people may be exposed. The dose levels used to assess risks are established to protect the most sensitive human population (e.g. children and nursing mothers).

The USEPA concluded after reviewing all the toxicity studies submitted for copper that the toxicological database was sufficient to assess the hazard from pesticides containing copper. The component of toxicological interest in copper-containing pesticides is elemental copper (cupric ion). Humans have homeostatic capabilities to regulate copper in the system. Effects such as severe dermal, eye and inhalation irritation seen in acute toxicity studies are the result of direct toxic action, rather than as a result of systemic toxicity. Acute toxicity studies are available for several of the copper compounds. These acute studies show that copper generally has low acute toxicity, with the exception of cuprous oxide for acute inhalation. Based on the available literature and the studies submitted by the registrants, the USEPA concluded that there was no evidence of copper or its salts being carcinogenic or posing any other systemic toxicity in animals having normal copper homeostasis. Thus, toxicological endpoints were not established to quantify any potential risks from exposure to copper.

A further conclusion in the RED was that there were no human health aggregate risks of concern resulting from aggregate diet-based and residential exposure.

The USEPA has not made a common mechanism of toxicity finding as to the copper ion and any other substances, and the copper ion does not produce toxic metabolites. For the purposes of this tolerance action, therefore, the USEPA has not assumed that the copper ion has a common mechanism of toxicity with other substances.

3.1.1 Occupational Exposure and Risk Assessment

Occupational risk is estimated by comparing potential exposures with the most relevant endpoint from toxicology studies being used to calculate a margin of exposure (MOE). This is compared to a target MOE incorporating safety factors protective of the most sensitive population group. If the calculated MOE is less than the target MOE, it does not necessarily mean that exposure will result in adverse effects, but mitigation measures to reduce risk would be proposed.

Workers can be exposed to copper when mixing, loading or applying the pesticide and when entering a treated site to conduct activities such as scouting and/or handling of treated crops.

Given no systemic toxicological endpoints of concern were identified for dermal exposures to coppers, no dermal, oral or inhalation endpoints of toxicological concern were established. Subsequently, quantitation of exposure from any route was not necessary, and occupational exposure to copper-containing pesticides was not identified as a concern in the RED. The USEPA concluded that the minimum handler personal protective equipment (PPE) (long-sleeved shirt and long pants, socks and shoes) for occupational workers will be required for application.

However, the USEPA concluded the severe irritating properties of some copper-containing pesticides warrant appropriate precautionary labelling to address any exposure. Each copper compound and its product formulations can cause different degrees of acute oral, dermal, eye and/or inhalation irritation effects.

The USEPA RED also indicated postapplication restrictions based on the Worker Protection Standard in 40 Code of Federal Regulations §170. Based on the acute toxicity of the copper compound, the minimum restricted-entry interval was 48 hours for those with greater acute toxicity categories.

The RED adequately addressed potential exposure scenarios associated with the Canadian uses of products containing copper, and conclusions derived from the RED apply to the Canadian situation. Basic application PPE and mitigation measures to address the irritation properties (based on the results of the acute toxicity tests of the specific copper active ingredient and the USEPA RED) are indicated in Appendix II.

3.1.2 Non-Occupational Exposure and Risk Assessment

3.1.2.1 Residential Exposure

Homeowners can be exposed to copper-containing pesticides when mixing, loading or applying the pesticide and when re-entering a treated site. Toddlers can be exposed via "hand-to-mouth" and "object-to-mouth" activities and through incidental soil ingestion.

The USEPA concluded there were no concerns for systemic toxicity resulting from exposure to copper-containing pesticides. The EPA also concluded the irritating properties of some of these compounds was of concern, but this concern could be addressed through appropriate precautionary label language. The PMRA agrees and has included specific statements for domestic class products in Appendix II.

3.1.2.2 Exposure From Food and Drinking Water

There are no diet-based concerns regarding use of copper-containing pesticides on food and feed crops reported in the USEPA RED. Thus, intake from drinking water was not of concern and no estimates of exposure were conducted. The United States indicated that tolerance exemptions of residues of copper in or on plant, animal and processed commodities established under Code of Federal Regulations 40 §180.1021 should be revised to include all current copper active ingredients with registered food uses and that existing tolerances for copper (1 ppm in potable

water and 3 ppm on pears) should be revoked. Canada concurs with the USEPA that a dietary (food and water) assessment is not necessary.

Currently, Canada allows a maximum residue of 50 ppm copper on fresh fruits and vegetables. No changes to the Canadian residue limits are proposed at this time.

3.1.2.3 Aggregate Risk Assessment

Aggregate risk combines the different routes of exposure to the copper ion (i.e. from food, water and residential exposures). Canada agrees with the USEPA; the lack of systemic toxicity of copper resulted in an aggregate risk assessment not being required.

Acute and chronic aggregate risk assessments are comprised of contributions from food and drinking water exposures.

Short-term and intermediate aggregate risk assessments are comprised of contributions from food, drinking water and non-occupational exposure (dermal, inhalation).

Overall, the Canadian aggregate exposure scenarios were adequately addressed by the USEPA aggregate risk assessment. Therefore, the USEPA conclusions are considered applicable to the uses of copper-containing pesticides in Canada.

3.1.3 Cumulative Effects

The USEPA has not determined whether the copper ion has a common mechanism of toxicity with other substances or whether it shares a toxic metabolite produced by other substances. Therefore, it was assumed that copper ion does not share a common mechanism of toxicity with other substances, and a cumulative risk assessment was not required.

3.2 Environment

The PMRA will evaluate the environmental impact of the antimicrobial use of copper-containing pesticides at a later date.

3.2.1 Environmental Risk Assessment

Copper occurs naturally in the environment and does not break down any further via hydrolysis, metabolism or any other degradation processes. The free cupric ion has a high sorption affinity for soil, sediments and organic matter, and copper applied to the surface is not expected to move readily into groundwater.

The copper ion is highly reactive, especially in aquatic environments. The concentrations of copper measured in soil or water can reflect naturally occurring and other point or non-point sources of copper besides pesticides. Copper can exist in various organic and inorganic forms, including the cupric ion (Cu^{2+}), cuprous ion (Cu^{+}), inorganic complexes, organic complexes and minerals. The form in which copper is found depends on the pH of the medium and the nature

and concentration of other forms of copper present. The American ecological assessment addressed terrestrial crop and direct aquatic uses of copper salts, oxides, hydroxides and organic complexes. For the purposes of that assessment, copper compounds reaching surface water (as simulated by the Pesticide Root Zone Model/Exposure Analysis Modelling System [PRZM/EXAMS]) are assumed to completely and instantaneously dissociate. Changes to the loading of dissolved copper were then simulated using the Biotic-Ligand Model (BLM).

The USEPA used the existing environmental database and open literature for coppers to characterize the environmental exposure associated with agricultural uses for their screening-level assessment. The risk assessment was based on a subset of representative labels of copper sulfate pentahydrate and copper hydroxide for agricultural uses, which represents a wide range of application rates. Both maximum label rates and typical average use rates were assessed. All copper concentrations are expressed in the risk assessments as the copper or cupric ion, the toxic ion of concern.

The USEPA ecological risk assessment compared toxicity endpoints from ecological toxicity data to estimated environmental concentrations (EECs) based on environmental fate characteristics, soil and water chemistry, and pesticide use data. To evaluate the potential risks to non-target organisms from the use of copper pesticides, a risk quotient (RQ), which is the ratio of the EEC to the most sensitive toxicity endpoint value, such as the median lethal dose (LD_{50}) or the median lethal concentration (LC_{50}), was calculated.

RQ values were compared to the levels of concern (LOCs), which indicate whether a pesticide, when used according to label instructions, has the potential to cause adverse effects on non-target organisms. When the RQ exceeds the LOC for a particular category, the USEPA presumes a potential risk of concern to that category. The USEPA concluded that in addition to the normal uncertainties present in any risk assessment, the imprecise label instructions represented the greatest source of uncertainty in the ecological risk assessment for copper-containing pesticides.

Copper is an essential nutrient required for proper homeostasis in all organisms. Most organisms have homeostatic mechanisms to process excess copper or to manage the deficiency of copper levels. However, aquatic animals are exposed to copper by more than just dietary routes, and are more sensitive to copper than terrestrial animals. The mode of toxicity for aquatic organisms is different than for terrestrial animals in that copper rapidly binds and causes damage to the gill membranes, and interferes with osmoregulatory processes. Aquatic plants, which are target organisms for most direct aquatic uses of copper, are also more sensitive to copper than terrestrial plants.

The toxicity of copper to aquatic animals depends on the amount of bioavailable cupric ion in the water. To address potential risk to freshwater organisms, the USEPA used the BLM (Windows Version 2.0.0, 4/03). The cupric ion does not degrade; thus, metabolism and degradation parameters were set with half-lives long enough that copper would essentially not degrade over the 30-year simulation. The one exception was the use of a 10-day aquatic dissipation half-life in place of an aerobic aquatic metabolism half-life in EXAMS.

The BLM, essentially a combined speciation and toxicity model, allows the calculation of toxicity values based on site-specific water chemistry. The BLM only estimates acute toxicity, so an acute-to-chronic ratio of 3.23 was applied to site specific LC_{50}s for daphnids and salmonids to estimate site-specific chronic toxicity values. The USEPA calculated an RQ for each of the 811 United States Geological Service sample sites and expressed the exceedences of the LOC in percentages for the sites.

The BLM has not yet been parameterized for estuarine/marine organisms as it has for freshwater animals. RQs for estuarine/marine animals were calculated using estimates of total dissolved copper and are, therefore, calculated using conservative exposure values. For freshwater plants, saltwater organisms and terrestrial animals and plants, standard USEPA models and methods were used to assess potential copper exposures.

Aquatic Organisms

Freshwater Fish and Invertebrates

Agricultural Uses

Thirty-two separate PRZM/EXAMS modeling scenarios were selected to represent the various crop groupings, which provided a range of geographic conditions and use rates. Use rates for copper sulfate, copper sulfate pentahydrate, and copper hydroxide were derived from representative labels. The modeling was conducted assuming four applications at weekly intervals.

At the maximum application label rate (36.3 kg a.i./ha), the RQs for nearly all sites exceeded the acute and chronic LOCs for invertebrates and fish. 'Typical' use rates of 1.14 to 8.55 kg a.i./ha resulted in acute LOCs being exceeded at 3.2 to 24.6% of the sites for freshwater invertebrates and <1% for fish. These rates resulted in chronic LOCs being exceeded by 4.2 to 32% for fresh water invertebrates and 0 to 5% for fish, respectively. This range of use rates covers the uses permitted in Canada.

Exposure by spray drift was not included as part of the potential total copper exposure in the BLM analysis. The assessment did not include spray drift because the labels did not specify the method by which the copper-containing pesticide would be applied. The analysis assumed drift loadings of 5% of the application rate for aerial spray and 1% of the application rate for ground spray onto the standard farm pond used in EXAMS. Peak concentrations of copper from spray drift were speciated using the BLM model to estimate the concentration of cupric ion in the pond. Median United States Geological Service monitoring site water quality data for the 811 sites were used as input parameters for the BLM model.

At the highest application rate (6.8 kg a.i./ha) proposed for reregistration in the United States, a single aerial application would result in 28% and 5% of sites exceeding the acute LOC for freshwater invertebrates and fish, respectively. A corresponding ground spray application would result in 7% and 4% exceedances, respectively.

The same simulated exposure suggests that the freshwater invertebrate endangered species LOC would be exceeded at 89% and 32% of sites from aerial and ground spray, respectively.

Aquatic Uses

The aquatic risk assessment for direct application of copper-containing pesticides to water uses the EXAMS model in conjunction with the BLM to produce RQs over a range of water quality conditions. EXAMS accounts for sediment-to-water partitioning, and the BLM incorporates the effects of copper speciation. The water body simulated by EXAMS is a 1-hectare, 2-metre deep pond with no outlet. Use data indicate a target concentration for algae and aquatic weeds control of 0.1–1 ppm. The risk assessment indicates that for an application rate of 1 ppm, peak concentrations of Cu^{2+} are predicted by EXAMS to be approximately 0.9 ppm if the pesticide were to be applied to the entire water body. The estimated average 21-day concentration at this rate is 522 ppb, and the estimated average 60-day concentration is 234 ppb.

For invertebrates, fish, and aquatic plants, >99% of sites exceed the endangered species LOC and the acute risk LOC at this application rate. The chronic risk LOCs for aquatic invertebrates and fish are exceeded at >96% of the sites. The USEPA concluded that, for almost any direct water application of copper products, there are likely to be effects on invertebrates. Fish and larger, more mobile invertebrates may be able to move out of the treated zone until the copper dissipates from the water column, but smaller and more sedentary invertebrates will be affected.

The permitted direct applications to water in Canada are included in the above scenario.

Freshwater Plants

Acute RQs based on the green algae, a target species for direct applications of copper to water, exceed the acute and acute endangered species LOC of 1.0 for application rates at or above 1.14 kg Cu^{2+}/ha. RQs for vascular plants (duckweed) did not exceed the acute or acute endangered species LOCs.

Estuarine/Marine Fish, Invertebrates and Plant Life

RQs for estuarine/marine animals and plants were calculated using estimates of total dissolved copper using PRZM/EXAMS, which overestimates the amount of copper that is potentially toxic to exposed organisms. In addition, the water body simulated by PRZM/EXAMS, a static farm pond with no outflow, is smaller than estuarine and marine water bodies, and PRZM/EXAMS does not take into account the dilutive effect of untreated seawater. Acute toxicity values for saltwater fish and invertebrates were selected based on the most sensitive assessed species. The most sensitive invertebrate is the mussel (*Mytilus),* with an LC_{50} of 6.49 ppb, and the most sensitive fish is the summer flounder *(Paralichthys dentatus)*, with an LC_{50} of 12.66 ppb. Chronic toxicity data were not available for estuarine/marine animals, so the acute toxicity ratio of 3.23 used for freshwater animals was used to derive chronic RQs for marine/estuarine animals.

The RQs for estuarine/marine organisms were calculated using the same regression on the peak copper concentrations that resulted from various application rates in the 32 PRZM/EXAMS simulations run for copper.

An application rate of 1.7 kg a.i./ha results in RQs exceeding the acute LOC for invertebrates and the chronic LOCs for fish. An application rate of 3.4 kg a.i./ha results in RQs exceeding the acute and chronic LOCs for invertebrates and fish.

With use levels up to 8.6 kg a.i./ha, RQs for estuarine/marine plants did not exceed the acute or acute endangered species LOC of 1.0.

Terrestrial Species

EECs for birds and small mammals were calculated using the Terrestrial Residue Exposure (T-REX, Version 1.1) model and based on typical food consumption parameters by various species, following application of 3.6 kg a.i./ha to 36 kg a.i./ha (row crop and orchard maximum label use, respectively) and 0.9 to 4.3 kg a.i./ha of copper (highest average rate, row crop and orchard, respectively). In this screening assessment, the USEPA assumed that organisms forage 100% of the time in a treated area and that 100% of their diet is comprised of a particular food item.

Birds

The highest label rate for orchard applications was for filberts (4.5 kg a.i./ha). At this application rate, all size classes of birds exceed the acute, acute endangered species and chronic LOCs for all food items.

The highest average rate for orchard applications was for apples (4.3 kg a.i./ha). At this application rate, all size classes of birds exceed the endangered species acute risk LOC and the chronic risk LOC for all food items. Birds consuming the short grass, tall grass and broadleaf plants food categories all exceed the acute risk and chronic risk LOCs, whereas with the fruit food item, larger birds and birds assessed with diet-based endpoints are below the acute risk LOC.

The highest label rate for row crop applications was for potatoes (3.6 kg a.i./ha). At this application rate, all size classes of birds consuming the short grass, tall grass and broadleaf plant food categories exceed the LOC. The small (20 g) and medium (100 g) birds consuming a diet of fruits, pods, seeds or large insects exceed the acute risk LOC using the dose-based calculation. All size classes of birds consuming all food types exceed the endangered species acute risk LOC and the chronic risk LOC.

The highest average rate for row crop applications was for potatoes (0.9 kg a.i./ha). At this application rate, birds consuming the short grass, tall grass and broadleaf plant categories exceed the endangered species acute risk LOC and the chronic risk LOC. Using dose-based RQs, all birds consuming these food categories also exceed the acute risk LOC. Only birds consuming short grass exceed the acute risk LOC using the diet-based RQs. Birds consuming the fruits and pods food category exceed the endangered species acute risk LOC using dose-based RQs, but not diet-based RQs. Only the small bird (20 g) in this category exceeds the acute risk LOC using the dose-based RQ.

Mammals
Acute RQs from dose-based acute mammalian studies have been adjusted to include a 22% absorption factor. As diet-based chronic data were available, the chronic dose-based values were not adjusted.

Acute RQs exceeded LOCs (RQs of 2.3 to 11.2; LOC of 0.5) at application rate of 36 kg a.i./ha (maximum label rate) for mammals feeding on short grass, tall grass, broadleaf plants and small insects. Chronic RQs exceeded LOCs (RQs of 2.2 to 381; LOC of 1.0) at the application rate of 36 kg a.i./ha for mammals feeding on short grass, tall grass, broadleaf plants, small insects, fruits, pods, seeds and large insects.

Acute RQs exceeded LOCs (RQs of 1.13 to 2.5; LOC of 0.5) at an application rate of 4.3 kg a.i./ha (apples) for mammals feeding on short grass. Chronic RQs exceeded LOCs (RQs of 2.4 to 85; LOC of 1.0) at the application rate of 4.3 kg a.i./ha for mammals feeding on short grass, tall grass, broadleaf plants, small insects, fruits, pods, seeds and large insects.

Chronic dose-based RQs for all size class mammals consuming grass, broadleaf plants and small insects exceeded the chronic LOC at an application rate of 0.9 kg a.i./ha.

Insects
Copper is practically nontoxic to honey bees, with an acute LD_{50} >100 µg/bee. However, because exposure estimates for other insects could not be readily determined, the potential risk of copper pesticides to other insects is unknown.

Terrestrial Plants
Terrestrial plant EECs were calculated based on the maximum application rate of 36 kg a.i./ha using the TERRPLANT model, which estimates copper residues in areas adjacent to the treated field.

The USEPA could not conduct a complete terrestrial plant risk assessment as the database was incomplete. However, after assessing the data in the USEPA Ecotoxicology Database (ECOTOX), it was concluded that it was unlikely that copper would pose a risk to terrestrial plants.

Overall Mitigation for Terrestrial Applications
The initial preliminary ecological risk assessment based on the label maximum agricultural application rates indicated significant risk exceedances for virtually all non-target organisms. However, the USEPA noted the assessments were highly conservative. Laboratory tests assume 100% of food consumed by animals will be treated at the maximum rate and at minimum retreatment intervals, whereas the actual use of products could be at lower rates, less frequently than allowed and the animals may also eat untreated food. In addition, animals repeatedly exposed to sublethal levels of copper may undergo enzymatic adaptation which allows them to cope with greater levels of exposure. These uncertainties are consistent with the lack of reported bird or mammal incidents.

The USEPA determined that a variety of risk mitigation measures would greatly reduce potential adverse exposures to non-target terrestrial animals, including lowering application rates, reducing the number of applications in a given year, restricting the timing of applications, extending the period between applications (application interval) and changing pesticide application methods to reduce the potential for spray drift or runoff. Subsequently, the USEPA concluded that the data are sufficient to support reregistration of all products containing copper that have registered terrestrial and aquatic (direct water application) agricultural uses, provided the risk mitigation measures are adopted.

The PMRA agrees with the USEPA's position and has calculated buffer zones for terrestrial uses to further protect the aquatic environment. Mitigation measures to protect the environment can be found in Appendix II.

3.2.2 Toxic Substances Management Policy Considerations

The management of toxic substances is guided by the 1995 federal TSMP, which puts forward a preventive and precautionary approach to deal with substances that enter the environment and could harm the environment or human health. The policy provides decision makers with direction and sets out a science-based management framework to ensure that federal programs are consistent with its objectives. One of the key management objectives is virtual elimination from the environment of toxic substances that result predominantly from human activity and that are persistent and bioaccumulative. These substances are referred to in the policy as Track 1 substances.

The federal TSMP and PMRA Regulatory Directive DIR99-03, *The Pest Management Regulatory Agency's Strategy for Implementing the Toxic Substances Management Policy*, were taken into account during the re-evaluation of pesticides containing copper. The PMRA has reached the following conclusions.

- Copper does not bioaccumulate. The *n*-octanol–water partition coefficient (log K_{ow}) is not applicable as copper is not soluble in water and octanol. The TSMP Track 1 cut-off criterion of ≥ 5.0. Copper is persistent, but binds to soil particles and becomes biologically unavailable Aerobic soil half-life is far above the TSMP Track 1 criterion of 182 days; therefore, copper is not a candidate for Track 1 classification.

- Based on a review of the available chemistry information (see Section 2.1), the technical product is not expected to contain impurities of toxicological concern as identified in Regulatory Directive DIR98-04 or TSMP Track 1 substances as identified in Regulatory Directive DIR99-03, Appendix II.

No other impurities of toxicological concern as identified in Regulatory Directive DIR98-04, Section 2.13.4, or TSMP Track 1 substances as identified in Regulatory Directive DIR99-03, Appendix II, are expected to be present in the technical products of copper.

Formulant issues are being addressed through PMRA formulant initiatives and Regulatory Directive DIR2006-02, *Formulants Policy and Implementation Guidance Document,* published on 31 May 2006.

4.0 Proposed Re-evaluation Decision

The PMRA has determined that the following copper-containing pesticides (cuprous oxide, cupric oxide, copper sulphate, copper sulphate pentahydrate, copper oxychloride, copper hydroxide and metallic copper powder) are acceptable for continued registration with the implementation of the proposed risk-reduction measures.

These measures are proposed to further protect human health and the environment. As a condition of the continued registration of copper uses, new risk-reduction measures are proposed for the labels of all products (see Appendix II). In addition, labels need to be upgraded to include maximum application rates, application interval (days) and seasonal maximum application rates. The recommendations in the USEPA RED document are provided for guidance (in pounds of Cu^{2+}/acre) (see Appendix IV). The PMRA is requesting comments as to the feasibility of these recommendations for Canadian use patterns. A submission to implement label revisions will be required within 90 days of finalization of the re-evaluation decision.

5.0 Supporting Documentation

PMRA documents, such as Regulatory Directive DIR2001-03, and DACO tables can be found on our website at www.pmra-arla.gc.ca. PMRA documents are also available through the Pest Management Information Service. Phone: 1-800-267-6315 within Canada or 1-613-736-3799 outside Canada (long distance charges apply); fax: 613-736-3798; e-mail: pmra_infoserv@hc-sc.gc.ca.

The federal TSMP is available through Environment Canada's website at www.ec.gc.ca/toxics.

The USEPA RED document for copper-containing pesticides (July 2006) is available on the USEPA Pesticide Registration Status page at www.epa.gov/pesticides/reregistration/status.htm.

List of Abbreviations

°C	degrees celcius
λ	wavelength
a.i.	active ingredient
ASAE	American Society of Agricultural Engineers
BLM	Biotic-Ligand Model
CAS	Chemical Abstracts Service
Cu^{2+}	cupric ion
Cu^{+}	cuprous ion
EC_{25}	effective concentration on 25% of the population
EEC	estimated environmental concentration
EXAMS	Exposure Analysis Modelling System
g	grams(s)
ha	hectare(s)
hr	hour(s)
kg	kilogram(s)
K_{ow}	*n*-octanol–water partition coefficient
km	kilometre(s)
kPa	kiloPascal
L	litre(s)
LC_{50}	median lethal concentration
LD_{50}	median lethal dose
LOC	level of concern
m	metre(s)
mg	milligram(s)
mL	millilitre(s)
MOE	margin of exposure
MRL	maximum residue limit
n/a	not applicable
nm	nanometre(s)
pH	-log10 hydrogen ion concentration
PMRA	Pest Management Regulatory Agency
ppb	parts per billion
PPE	personal protective equipment
ppm	parts per million
PRZM	Pesticide Root Zone Model
PRVD	Proposed Re-evaluation Decision
RED	Reregistration Eligibility Decision
RQ	risk quotient
TGAI	technical grade active ingredient
TSMP	Toxic Substances Management Policy
µg	microgram(s)
USEPA	United States Environmental Protection Agency
UV	ultraviolet

Appendix I Registered Products Containing Copper Pesticides as of August 2008

Registration Number	Marketing Class	Registrant	Product Name	Formulation Type	Guarantee (%)
Cuprous Oxide					
21241	Technical	American Chemet Corporation	Technical High Performance Chem Copp	Dust or powder	88
21242	Technical	American Chemet Corporation	Lolo Tint 97 Technical	Not applicable or not available	94
21243	Technical	American Chemet Corporation	Technical Purple Copp 97N	Dust or powder	95
21244	Technical	American Chemet Corporation	Red Copp 97N Technical	Dust or powder	95
21351	Domestic	International Paint LLC.	Interlux MicronCSC Black 483 (Cu477483) and Other Colours	Solution	36
21352	Domestic	International Paint LLC.	Interlux MicronCSC Shark White 484 (Cu471484)	Solution	36
21354	Domestic	International Paint LLC.	Interlux Bottomkote XXX Blue 69 (Cu474069) and Other Colours	Solution	28.15 (25)
21355	Domestic	International Paint LLC.	Interlux Fibreglass Bottomkote Blue 669 (Cu474669) and Other Colours	Solution	44.14
21378	Commercial	International Paint LLC.	Interspeed Bla110 Premium Red	Solution	23 (21)
21379	Commercial	International Paint LLC.	Union Jack Bca350 Copper Red (Za469005)	Solution	19
21397	Commercial	International Paint LLC.	Interclene Bra542 Black (Za467003) and Bra540 Red (Za463007)	Solution	38.28 (34.0)
21652	Commercial	International Paint LLC.	Epoxycop (Various Colors)	Suspension	42 (37.30)
21656	Commercial	Hempel Coatings (Canada), Inc.	Hempel's Antifouling Olympic 7660-5111 Red	Suspension	45.31
21657	Commercial	Hempel Coatings (Canada), Inc.	Hempel's Antifouling Olympic 7660-5030 Light Red	Suspension	45.31
21658	Commercial	Hempel Coatings (Canada), Inc.	Hempel's Antifouling Olympic 7660-1999 Black	Solution	45.31
21659	Commercial	Hempel Coatings (Canada), Inc.	Hempel's Antifouling Pacific U7609-5000 Red	Solution	36.01
21703	Commercial	Kop-Coat Inc.	Pettit Premium Line Premium Performance AF (3 Colours)	Solution	37.5 (33.3)
21840	Commercial	International Paint LLC.	West Marine Bottomshield Antifouling Bottom Paint (Various Colours)	Solution	42.56 (37.60)

Registration Number	Marketing Class	Registrant	Product Name	Formulation Type	Guarantee (%)
21841	Commercial	International Paint LLC.	Tarr and Wonson Copper Paint Red 503-C	Solution	25.67 (22.8)
21986	Commercial	Flexabar Corp.	Flexgard XI Waterbase Preservative	Emulsifiable concentrate or emulsion	26.5
22022	Domestic	International Paint LLC.	VC-Offshore Teflon Antifouling Saltwater Formula (Three Colours)	Solution	41.66
22088	Technical	Nordox Industries A S	Nordox Cuprous Oxide Powder	Dust or powder	97
22327	Technical	SCM Metal Products, Inc.	SCM Metal Products Cuprous Oxide	Dust or powder	88.44
22717	Commercial	International Paint LLC.	Interspeed 640 Antifouling Series (Ocean Green, Red, Black, Blue)	Not applicable or not available	42.79 (38.0)
22718	Domestic	International Paint LLC.	C-Shield Red Antifouling Paint (469040)	Solution	10.13 (9)
22727	Domestic	International Paint LLC.	C-Swift Antifouling Paint (3 Colours)	Solution	41
22728	Domestic	International Paint LLC.	C-Union Jack Antifouling Paint (Red)	Solution	19
22820	Domestic	International Paint LLC.	C-Speed Antifouling Paint (Red) 469038	Not applicable or not available	23 (21)
23511	Commercial	Laurentide Chemicals Atlantic Ltd	Atlantic Antifouling Paint Copper Bottom Red	Suspension	8.78
23803	Commercial	Flexabar Corp.	Flexgard VI Waterbase Preservative	Emulsifiable concentrate or emulsion	15.3
24097	Commercial	Kop-Coat Inc.	West Marine CPP! Plus Ablative Antifouling Paint (Blue, Red, Black, Green)	Emulsifiable concentrate or emulsion	47.5 (42.1)
24183	Commercial	Steen-Hansen Maling AS	Aqua Net (Water Soluble Impregnation/Agent For Cages And Ropes)	Suspension	16.41
24389	Domestic	International Paint LLC.	Aquarius Polishing Water Based A/F Series (Various Colours)	Solution	49.73 (44.17)
24390	Commercial	International Paint LLC.	Interclene 140 Bwa 360 Antifouling Red	Solution	38.2 (33.93)
24391	Commercial	International Paint LLC.	Interclene Bca127 Premium Antifouling Red	Solution	21.73
24392	Domestic	International Paint LLC.	Fiberglass Bottomkote (High Solic's Series)	Solution	42.67 (37.90)
24393	Domestic	International Paint LLC.	Micron Csc Extra Antifouling Paint	Solution	37.04
24394	Domestic	International Paint LLC.	Ultra-Kote A/F 2449H Red and 2669H Blue	Solution	72.18 (64.10)

Registration Number	Marketing Class	Registrant	Product Name	Formulation Type	Guarantee (%)
24395	Domestic	International Paint LLC.	Ultrakote A/F Series	Solution	65.71 (58.36)
24409	Commercial	Flexdel Corp	Aquagard Waterbase Antifouling Bottom Boat Paint	Emulsifiable concentrate or emulsion	26.6 (23.6)
25788	Commercial	Jotun Paints Inc.	Antifouling Hydroclean Low VOC (Various Colours)	Suspension	44.59
25809	Commercial	Arch Wood Protection Canada Corp.	Chemonite Wood Preservative	Solution	6.5
26589	Commercial	Ameron	Amercoat ABC #4 Antifouling Paint	Suspension	29.2
26709	Domestic	International Paint LLC.	Fiberglass Bottomkote Act Antifouling Paint	Solution	41.97
26907	Commercial	Sasol Wax GMBH	Netrex AF Microcrystalline Wax	Emulsifiable concentrate or emulsion	17
26991	Commercial	Ameron	Amercoat ABC #3 Antifouling Paint Red	Suspension	42
27098	Commercial	International Paint LLC.	Interclene Bra 570 Antifouling Series	Suspension	37.2
27131	Commercial	Timber Specialties Co.	NW 100 Wood Preservative Concentrate	Solution	7.4
27153	Commercial	Solignum Inc.	Solignum EX-84 Waterbase Preservative Net Coating	Solution	22.4
27277	Commercial	Kop-Coat Inc.	Horizons Ablative Antifouling Bottom Paint	Solution	47.5
27442	Commercial	Kop-Coat Inc.	Unepoxy Antifouling Finish (Blue)	Solution	33.3
27443	Commercial	Kop-Coat Inc.	Unepoxy Antifouling Finish - Red	Solution	33.3
27444	Commercial	Kop-Coat Inc.	Unepoxy Antifouling Finish - Black	Solution	33.3
27522	Commercial	Sigmakalon Usa, LLC.	5297Hs Sigmaplane Ecol Antifouling Paint (Red Brown Colour)	Suspension	37
27573	Commercial	International Paint LLC.	123 Paint Vinyl Antifouling (Za469033)	Solution	60
27574	Domestic	International Paint LLC.	Interlux Viny-Lux Black 360, Green 339, Blue 340	Solution	33.78
27575	Domestic	International Paint LLC.	Interlux Viny-Lux Red 350 Vinyl Antifouling Paint (Cu479350)	Solution	42.79
27977	Technical	American Chemet Corporation	Chem Copp Hp III	Solid	88
28046	Commercial	IKO Industries Ltd	AR Granules	Granular	5.15

Registration Number	Marketing Class	Registrant	Product Name	Formulation Type	Guarantee (%)
Copper Sulfate Pentahydrate					
12952	Domestic	Sani-Marc Inc.	Sani-Marc Permanent Algaecide	Solution	2.57
17668	Domestic	C-Pool Chemical Inc.	C-Pool Mineral Treatment Swimming Pool Algaecide	Granular	12.5
18212	Technical	E.I. Du Pont Canada Company	Blue Viking - Technical	Not applicable or not available	25.2
21675	Commercial and Restricted	Nalco Canada Company	Cuprose	Soluble granules	18.9
21699	Commercial	Phyton Corporation	Phyton 27 Bactericide and Fungicide	Solution	5.5
21768	Technical	Teck Cominco Metals Ltd.	Cupric Sulphate Technical	Solid	25.2
21870	Domestic	Enviro-Science Laboratories Inc.	Bluemagic Bacteriostatic Algaecide	Solution	5
21957	Domestic	Sani-Marc Inc.	Algiban Gran Granular Algicide	Soluble granules	3.4
22019	Commercial and Restricted	Teck Cominco Metals Ltd.	Cupric Sulphate Pentahydrate	Solid	99.0 (25.2)
23636	Commercial	Envireau Technologies Inc.	Polydex Bacteriostatic Algicide	Solution	5
23809	Domestic	Sera Aquaristik Canada Limited	Sera Pondclear Pond Water Treatment	Solution	0.33
23811	Technical	Phelps Dodge Refining Corporation	Triangle Brand Cupric Sulphate Pentahydrate	Soluble powder	25.2
24034	Commercial	Phelps Dodge Refining Corporation	Triangle Brand Copper Sulphate Instant Powder	Soluble powder	25.2
24200	Commercial	Phelps Dodge Refining Corporation	Triangle Brand Copper Sulphate Crystal	Soluble powder	25.2
24952	Domestic	DMC H20 Inc.	Crystalline H2O	Soluble granules	5
25435	Domestic	224625 4082	Blue Stone Pool Water Treatment Algaecide	Soluble granules	99 (25.2)
25439	Domestic	Bio-Lab Canada Inc.	BioGuard Erase Liquid Algaecide	Solution	3.3
25466	Domestic	Hydrotech Chemical Corporation	Guardex Algae Master	Solution	3.3
25469	Domestic	Sani-Marc Inc.	Sani-Marc Perma + Algaecide	Solution	5
25470	Domestic	Sani-Marc Inc. D.B.A. Calypso	Calypso Permalgicide	Solution	5
25603	Domestic	Bio-Lab Canada Inc.	BioGuard Hibernate Algicide II	Solution	2.7
25624	Domestic	Purity	Purity Knock Out Algaecide	Solution	5
25692	Technical	Algaefree Australia	Copper Sulphate Technical	Dust or powder	25.3
25693	Domestic	Algaefree Australia	Pool Blocks All Seasons	Tablet	6.4

Registration Number	Marketing Class	Registrant	Product Name	Formulation Type	Guarantee (%)
			Algicide		
25837	Domestic	Cristal Bleu	Cristal Bleu Controls Algae	Granular	25.2
26224	Domestic	Hydrotech Chemical Corporation	Guardex Winterguard Algicide	Solution	2.7
26292	Domestic	Solutions H2O	Crystal Solution	Soluble powder	16
26848	Domestic	Crystal Clear Pool & Spa - 1266350 Ontario Inc.	Eclipse 3	Soluble granules	13
27002	Domestic	Rudbecom Inc.	Crystal Plus System	Soluble powder	16
27178	Domestic	HG Spec Inc.	Crystal Pond Algaecide	Solution	0.33
27179	Domestic	HG Spec Inc.	Water Garden Algaecide	Solution	0.33
27334	Domestic	Bio-Lab Canada Inc.	BioGuard Banish	Solution	1.71
27371	Domestic	Organic Water Inc.	H2 Original - Algaecide	Soluble granules	3.74
27434	Commercial	Axsys Direct Manufacturing	Think Purity Algaecide And Odour Control Solution	Solution	5
27536	Commercial	Boss Technology Inc.	Algi-Boss	Solution	5
27655	Domestic	Hydrotech Chemical Corporation	Guardex Algae Free	Solution	1.71
27716	Domestic	Rudbecom Inc.	Trevi Bleu	Soluble powder	16
27754	Commercial	Axsys Direct Manufacturing	Think Purity Algaecide Solution	Solution	5
27768	Commercial	Envireau Technologies Inc.	Biodex Bacteriostatic	Solution	5
27769	Commercial	Envireau Technologies Inc.	Polypro Algaecide	Solution	5
27770	Commercial	Envireau Technologies Inc.	Polydex Algaecide MC	Solution	5
27791	Domestic	Asepsis Inc.	Omni Algae Terminator	Solution	3.3
27959	Domestic	Recreational Water Products Inc	Aqua Chem Algaecide Plus	Solution	3.3
28115	Domestic	ABC-Pools	Excel	Soluble granules	13
28187	Domestic	I.P.G/G.P.I Independant Pool Group Inc.	Aquapro Algi Ban Gran Granular Algaecide	Soluble granules	3.4
28206	Domestic	I.P.G/G.P.I Independant Pool Group Inc.	Aquapro Perma Plus Algaecide	Solution	5
28344	Domestic	Rudbecom Inc.	Aquarine	Soluble powder	16
28411	Commercial	Boss Technology Inc.	Agri-Boss Bacteriostatic Algaecide	Solution	5
28412	Commercial	Boss Technology Inc.	Enviro-Boss Bacteriostatic Algaecide	Solution	5
28866	Commercial	Pond Wizard Products	Pond Wizard Algaecide	Solution	5
Copper Oxychloride					
13245	Commercial	Univar Canada Ltd.	Guardsman Copper Oxychloride 50	Wettable powder	50

Registration Number	Marketing Class	Registrant	Product Name	Formulation Type	Guarantee (%)
16106	Domestic	Sure-Gro IP Inc.	Later's Potato and Tomato Dust Insecticide Fungicide	Dust or powder	7
16140	Domestic	Sure-Gro IP Inc.	Later's Copper Spray W.P. Fungicide	Wettable powder	50
19146	Commercial	United Agri Products Canada Inc.	Copper Spray Fungicide	Wettable powder	50
19300	Technical	Universal Crop Protection Ltd.	Copper Oxychloride Technical	Dust or powder	57.7
24839	Technical	United Agri Products Canada Inc.	Copper Oxychloride Technical	Dust or powder	58
25123	Commercial	Beaver Plastics Ltd.	Root Trim	Suspension	6.9
Copper Hydroxide					
14417	Commercial	E.I. Du Pont Canada Company	Kocide 101 Fungicide	Wettable powder	50
16047	Commercial	United Agri Products Canada Inc.	Coppercide WP Fungicide	Wettable powder	50
24267	Commercial	Texel Inc.	Tex-R Fabric For Vegetation Control	Impregnated fabric	6
24268	Commercial	Texel Inc.	Tex-R Pro (Fabric For Vegetation Control)	Impregnated fabric	6
24538	Commercial	E.I. Du Pont Canada Company	Kocide DF Fungicide/Bactericide	Soluble granules	61.4
24670	Technical	Nufarm Agriculture Inc.	Champion Technical	Solid	57.3
24671	Commercial	Nufarm Agriculture Inc.	Parasol Wettable Powder Fungicide	Wettable powder	50
25234	Domestic	Buckman Laboratories of Canada Ltd.	Busan 1333 Controls Chlorine-Resistant Algae	Solution	2
25275	Domestic	C.L. Marketing Inc.	Tabex Algysolve 2250	Solution	2
25580	Commercial	Genics Inc.	Cobra (TM) Rod	Solid	1.8
25901	Commercial	Nufarm Agriculture Inc.	Parasol Flowable Fungicide	Suspension	24.4
26461	Domestic	C.L. Marketing Inc.	Foxxx Algaezone Plus	Solution	2
26881	Manufacturing Concentrate	Sepro Corporation	Spin Out 260	Suspension	12.8
26995	Commercial	Texel Inc.	Tex'R Propagation Fabric For Weed Control	Impregnated fabric	4.5
26996	Commercial	Texel Inc.	Tex'R Geodisc	Impregnated fabric	3.2
27119	Commercial	Sepro Corporation	Spin-Out Root Growth Regulator	Suspension	4.6
27214	Domestic	Genics Inc.	Genics Post Guard	Solid	1.71
27348	Commercial	E.I. Du Pont Canada Company	Kocide 2000	Soluble granules	53.8
27503	Technical	E.I. Du Pont Canada Company	Kocide Copper Hydroxide Technical	Solid	61
27553	Commercial	Genics Inc.	Cobra (TM) Crush MDT	Soluble powder	6.1

Registration Number	Marketing Class	Registrant	Product Name	Formulation Type	Guarantee (%)
			Wood Preservative		
27621	Commercial	Copper Care Wood Preservatives Inc.	Cu-Bor Remedial Wood Preservative	Paste	2
28406	Commercial	Nufarm Agriculture Inc.	Parasol DP Fungicide	Wettable granules	37.5
Copper Sulphate					
9934	Commercial	United Agri Products Canada Inc.	Copper 53W Wettable Powder	Wettable powder	53
17424	Domestic	Sure-Gro IP Inc.	Wilson Garden Doctor Insecticide-Fungicide	Dust or powder	7
17482	Domestic	Sure-Gro IP Inc.	Wilson Bordo Copper Spray Wettable Powder Fungicide	Wettable powder	53
Metallic Copper Powder					
21372	Domestic	International Paint LLC.	Interlux Fibreglass Bottomkote Racing Bronze 999 (Anti-Fouling)	Solution	28
22020	Domestic	International Paint LLC.	VC 17M Teflon Antifouling Red V107 and Blue V106 and Graphite V105	Solution	20.25
22021	Domestic	International Paint LLC.	VC18 Powerboat Antifouling Paint With Teflon (3 Colours)	Solution	17.6
22089	Technical	Canbro Inc.	Copper Flake Powder 566	Dust or powder	99.6
27903	Technical	Wolstenholme International	Copper Flake Technical	Dust or powder	99.1
Cupric Oxide					
19612	Commercial	Timber Specialties Co.	Timber Specialties K-33 (C-60) Wood Preservative	Solution	10.5
21226	Commercial	Arch Wood Protection Canada Corp.	Wolmanac 60% Industrial Concentrate	Solution	11.1
21589	Technical	Chemical Specialties Inc.	CCA Type-C Wood Preservative	Solution	11.4
24741	Technical	Adchem (Australia) Pty Ltd.	Cupric Oxide Technical Grade	Dust or powder	97.5
26826	Technical	Peninsula Copper Industries,Inc.	Cupric Oxide	Dust or powder	98.64
27122	Technical	Arch Wood Protection Canada Corp.	Arch Cor Oxide	Solid	77.5
27132	Commercial	Arch Wood Protection Canada Corp.	Wolman NB	Solution	9.25
27368	Commercial	Chemical Specialties Inc.	CCA Type-C (60%) Wood Preservative - Commercial Use	Solution	11.4

The number in parenthesis in the Guarantee (%) column is the guarantee of elemental copper.

Appendix II Label Amendments for Products Containing Copper

The label amendments presented below do not include all label requirements for individual end-use products, such as first aid statements, disposal statements, precautionary statements and supplementary protective equipment. Additional information on labels of currently registered products should not be removed unless it contradicts the label statements below.

The labels of end-use products in Canada must be amended to include the following statements to further protect workers and the environment.

A. For all uses of domestic class products except for swimming pool uses:

I) The following statements must be included in a section entitled **PRECAUTIONS**.

Users should wash hands before eating, drinking, chewing gum, using tobacco or using the toilet.

For products applied as spray: DO NOT allow adults, children or pets to enter the treated area until sprays have dried.

For products applied dry: DO NOT allow adults, children or pets to enter the treated area until dusts have settled.

II) The following statements must be included in a section entitled **DIRECTIONS FOR USE**.

DO NOT apply this product in a way that will contact adults, children or pets, either directly or through drift.

DO NOT apply to any body of water.

Avoid application of this product when winds are gusty.

DO NOT contaminate irrigation or drinking water supplies or aquatic habitats by cleaning of equipment or disposal of wastes.

III) The following statements must be included in a section entitled **ENVIRONMENTAL HAZARDS.**

TOXIC to aquatic organisms and non-target terrestrial plants.

To reduce runoff from treated areas into aquatic habitats avoid application to areas with a moderate to steep slope, compacted soil or clay.

Avoid application when heavy rain is forecast.

Contamination of aquatic areas as a result of runoff may be reduced by including a vegetative strip between the treated area and the edge of the water body.

B. For swimming pool uses on domestic class product labels:

I) The following statements must be included in a section entitled **PRECAUTIONS**.

a) For all formulations:

Users should wash hands before eating, drinking, chewing gum, using tobacco or using the toilet.

Wipe clean all surfaces that come into direct contact with food, such as counters, tables and stovetops.

Always store this product out of reach of children and pets and away from food and beverages.

b) For dusts/powders:

DO NOT allow adults, children or pets to enter the treated area until dusts have settled.

II) The following statements must be included in a section entitled **DIRECTIONS FOR USE**.

a) For all formulations:

DO NOT contaminate irrigation or drinking water supplies or aquatic habitats by cleaning of equipment or disposal of wastes.

b) For dusts/powders:

DO NOT apply this product in a way that will contact adults, children or pets, either directly or through drift.

Avoid application of this product when winds are gusty.

c) For granules/tablets:

DO NOT apply this product in a way that will result in direct contact with adults, children or pets.

C. For commercial class products:

I) The following statements must be included in a section entitled **PRECAUTIONS**.

Mixers, loaders, applicators and other handlers must wear long-sleeved shirt, long pants and shoes plus socks.

Follow manufacturer's instructions for cleaning/maintaining personal protective equipment. If no such instructions for washables exist, use detergent and hot water. Keep and wash personal protective equipment separately from other laundry.

Discard clothing and other absorbent material that have been drenched or heavily contaminated with the product's concentrate. Do not reuse them.

Users should wash hands before eating, drinking, chewing gum, using tobacco or using the toilet.

Users should remove clothing/personal protective equipment immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing.

Users should remove personal protective equipment immediately after handling this product. As soon as possible, wash thoroughly and change into clean clothing.

DO NOT apply this product in a way that will contact workers or other persons, either directly or through drift. Only protected handlers may be in the area during application.

If gloves are required on the label, wash the outside of gloves before removing.

For agricultural uses only:

DO NOT enter or allow worker entry into treated areas during the restricted entry interval of 48 hours for:

Copper hydroxide
Copper oxychloride
Basic copper sulfate
Copper sulfate pentahydrate

Products containing any of the copper compounds listed directly below require the following statement: Notify workers of the application by warning them orally and by posting warning signs at entrances to treated areas.

Copper oxychloride
Basic copper sulfate
Cuprous oxide

For non-agricultural uses:

Do not enter or allow others to enter until sprays have dried.

or

Do not enter or allow others to enter until dusts have settled.

II) The following statements must be included in a section entitled **DIRECTIONS FOR USE**.

DO NOT apply this product directly to freshwater habitats (such as lakes, rivers, sloughs, ponds, prairie potholes, creeks, marshes, streams, reservoirs and wetlands), estuarine/marine habitats.

DO NOT contaminate irrigation or drinking water supplies or aquatic habitats by cleaning of equipment or disposal of wastes.

The following statement is required on all agricultural or commercial products, unless aerial application is permitted:

DO NOT apply by air.

III) The following statements must be included in a section entitled **ENVIRONMENTAL HAZARDS.**

To reduce runoff from treated areas into aquatic habitats avoid application to areas with a moderate to steep slope, compacted soil, or clay.

Avoid application when heavy rain is forecast.

Contamination of aquatic areas as a result of runoff may be reduced by including a vegetative strip between the treated area and the edge of the water body.

For labels that include direct aquatic uses, include the following statement:

For use in water wholly confined to the property of the user and where there is no outflow beyond the property limits.

For end-use products that include use of copper compounds to treat potable water sources, the following statement must be included:

Potable water sources treated with copper products may be used as drinking water only after proper additional potable water treatments.

For buffer zones:

I) The following statements must be included in a section entitled **ENVIRONMENTAL HAZARDS.**

TOXIC to aquatic organisms and non-target terrestrial plants. Observe buffer zones specified under DIRECTIONS FOR USE.

II) The following statements must be included in a section entitled **DIRECTIONS FOR USE.**

Field sprayer application: DO NOT apply during periods of dead calm. Avoid application of this product when winds are gusty. DO NOT apply with spray droplets smaller than the American Society of Agricultural Engineers (ASAE) medium classification. Boom height must be 60 cm or less above the crop or ground.

Airblast application: DO NOT apply during periods of dead calm. Avoid application of this product when winds are gusty. DO NOT direct spray above plants to be treated. Turn off outward pointing nozzles at row ends and outer rows. DO NOT apply when wind speed is greater than 16 km/hr at the application site as measured outside of the treatment area on the upwind side.

Aerial application: DO NOT apply during periods of dead calm. Avoid application of this product when winds are gusty. DO NOT apply when wind speed is greater than 16 km/hr at flying height at the site of application. DO NOT apply with spray droplets smaller than the American Society of Agricultural Engineers (ASAE) medium classification. To reduce drift caused by turbulent wingtip vortices, the nozzle distribution along the spray boom length MUST NOT exceed 65% of the wing- or rotorspan.

Use of the following spray methods or equipment DO NOT require a buffer zone: hand-held or backpack sprayer and spot treatment.

The buffer zones specified in the table below are required between the point of direct application and the closest downwind edge of sensitive terrestrial habitats (such as grasslands, forested areas, shelter belts, woodlots, hedgerows, riparian areas and shrublands), sensitive freshwater habitats (such as lakes, rivers, sloughs, ponds, prairie potholes, creeks, marshes, streams, reservoirs and wetlands) and estuarine/marine habitats.

Method of application	Crop		Buffer Zones (metres) Required for the Protection of:				
			Freshwater Habitat of Depths:		Estuarine/Marine Habitats of Depths:		Terrestrial habitat
			Less than 1 m	Greater than 1 m	Less than 1 m	Greater than 1 m	
Field sprayer*	Outdoor flowers / ornamentals		10	5	5	3	0
	Flowering Prunus, Forsythia, Lilac, Rose, Cranberry		15	5	10	4	0
	Potatoes, peppers, eggplant		40	20	20	10	1
	Strawberries, squash, pumpkin, melon, watermelon, cucumbers, onion, celery		20	10	10	5	1
	Beet		25	10	15	5	1
	Carrot, cabbage, broccoli, cauliflower		25	10	10	5	1
	Spinach		15	5	10	4	0
	Tomatoes		45	20	25	10	1
	Beans		35	15	20	10	1
	Hops		25	10	10	5	1
Airblast	Apricots Peaches (except leaf curl)	Early growth stage	45	35	40	30	0
		Late growth stage	35	30	30	20	0
	Peach (leaf curl)	Early growth stage	40	30	30	20	0
	Cottoneaster, crabapple, hawthorn, mountain ash, quince	Late growth stage	40	30	35	25	0

Method of application	Crop		Buffer Zones (metres) Required for the Protection of:				
			Freshwater Habitat of Depths:		Estuarine/Marine Habitats of Depths:		Terrestrial habitat
			Less than 1 m	Greater than 1 m	Less than 1 m	Greater than 1 m	
	Arborvitae, cedar, fir, juniper, pine, spruce	Early growth stage	55	45	45	40	1
		Late growth stage	45	35	35	30	1
	Raspberries	Early growth stage	55	45	50	40	1
		Late growth stage	45	35	40	30	1
	Sweet and sour cherries	Early growth stage	55	45	45	35	1
		Late growth stage	45	35	35	25	1
	Grapes	Early growth stage	60	55	55	45	2
		Late growth stage	50	45	45	35	2
	Walnuts	Early growth stage	50	45	45	35	1
		Late growth stage	40	35	35	25	1
	Apple, pear	Early growth stage	60	50	50	40	1
		Late growth stage	50	40	40	35	1
	Currants, gooseberries	Early growth stage	55	45	50	40	1
		Late growth stage	45	35	40	30	1

Method of application	Crop		Buffer Zones (metres) Required for the Protection of:				
			Freshwater Habitat of Depths:		Estuarine/Marine Habitats of Depths:		Terrestrial habitat
			Less than 1 m	Greater than 1 m	Less than 1 m	Greater than 1 m	
	Sour cherries (brown rot, leaf rot)	Early growth stage	55	45	45	40	1
	Blueberry (highbush)	Early growth stage	55	45	50	40	1
		Late growth stage	45	35	40	30	1
	Nectarines	Early growth stage	45	35	40	30	0
		Late growth stage	35	25	30	20	0
	Filbert/ Hazelnut	Early growth stage	55	50	50	40	1
		Late growth stage	45	40	40	30	1
Aerial	Peppers	Fixed-wing	200	125	150	85	0
		Rotary-wing	125	80	90	55	0
	Potatoes (early and late blight)	Fixed-wing	200	125	125	60	0
		Rotary-wing	125	75	80	40	0
	Potatoes (late blight during harvest)	Fixed-wing	200	125	150	85	0
		Rotary-wing	125	80	90	55	0
	Tomatoes	Fixed-wing	200	125	150	75	1
		Rotary-wing	125	75	85	45	1

* For field sprayer application, buffer zones can be reduced with the use of drift reducing spray shields. When using a spray boom fitted with a full shield (shroud, curtain) that extends to the crop canopy, the labelled buffer zone can be reduced by 70%. When using a spray boom where individual nozzles are fitted with cone-shaped shields that are no more than 30 cm above the crop canopy, the labelled buffer zone can be reduced by 30%.

Appendix III Inputs to Buffer Zone Models

Ground Use Data (from Canadian labels)				
Crop	**Formulation Type**	**Method of Application**	**Number of Application**	**Maximum Application Rate (g a.i./ha)**
Celery	Wettable powder	Field (medium)	5	2000
Sweet/sour cherries	Wettable powder	Early airblast	2	4500
Sweet/sour cherries	Wettable powder	Late airblast	2	4500
Outdoor flowers/ornamentals	Solution	Field (medium)	10	429
Apricot, peaches	Wettable powder	Early airblast	1	4500
Apricot, peaches	Wettable powder	Late airblast	1	4500
Peach	Wettable powder	Early airblast	2	1000
Cottoneaster, crabapple, hawthorn, mountain ash, quince	Wettable powder	Late airblast	10	625
Arborvitae, cedar, fir, juniper, pine, spruce	Wettable powder	Early airblast	5	2000
Arborvitae, cedar, fir, juniper, pine, spruce	Wettable powder	Late airblast	5	2000
Raspberries	Wettable powder	Early airblast	4	2650
Raspberries	Wettable powder	Late airblast	4	2650
Grapes	Wettable powder	Early airblast	7	3000
Grapes	Wettable powder	Late airblast	7	3000
Celery	Wettable powder	Field (medium)	5	2000
Flowering *Prunus* spp.	Wettable powder	Field (medium)	2	3000
Forsythia, lilac, rose	Wettable powder	Field (medium)	2	3000

Ground Use Data (from Canadian labels)				
Crop	**Formulation Type**	**Method of Application**	**Number of Application**	**Maximum Application Rate (g a.i./ha)**
Walnuts	Wettable powder	Early airblast	4	2000
Walnuts	Wettable powder	Late airblast	4	2000
Apple trees	Wettable powder	Early airblast	2	2000
Apple trees	Wettable powder	Late airblast	2	2000
Potatoes	Solution	Field (medium)	10	2000
Apple, pear	Wettable powder	Early airblast	10	1590
Apple, pear	Wettable powder	Late airblast	10	1590
Currants, gooseberries	Wettable powder	Early airblast	4	2650
Currants, gooseberries	Wettable powder	Late airblast	4	2650
Apple cultivars (Mutsu-Crispin; Jonasgold)	Wettable powder	Early airblast	3	1590
Apple cultivars (Mutsu-Crispin; Jonasgold)	Wettable powder	Late airblast	3	1590
Strawberries	Wettable powder	Field (medium)	5	2014
Beet	Wettable powder	Field (medium)	6	2120
Carrot, cabbage, broccoli, cauliflower	Wettable powder	Field (medium)	5	2120
Squash, pumpkin, melon, watermelon	Wettable powder	Field (medium)	5	1590
Peppers, eggplant	Wettable powder	Field (medium)	10	2120
Tomatoes	Suspension	Field (medium)	10	2385
Cucumbers	Suspension	Field (medium)	5	2000

Ground Use Data (from Canadian labels)				
Crop	**Formulation Type**	**Method of Application**	**Number of Application**	**Maximum Application Rate (g a.i./ha)**
Beans	Wettable powder	Field (medium)	6	2915
Sour cherries	Wettable powder	Early airblast	10	1000
Hops	Wettable powder	Field (medium)	4	2650
Cranberry	Wettable powder	Field (medium)	3	2000
Onion	Wettable powder	Field (medium)	6	1500
Blueberry (Highbush)	Wettable powder	Early airblast	6	2000
Blueberry (Highbush)	Wettable powder	Late airblast	6	2000
Spinach	Wettable powder	Field (medium)	5	1325
Nectarines	Wettable powder	Early airblast	2	2120
Nectarines	Wettable powder	Late airblast	2	2120
Filbert, hazelnut	Wettable powder	Early airblast	3	4500
Filbert, hazelnut	Wettable powder	Late airblast	3	4500

Model Input Data for Aquatic Buffer Zones (from 2006 RED)		
Half-life for aquatic buffer zones	Stable	—
Most sensitive amphibian species	*Rana pipiens*	1/10 LC_{50} = 15.00 µg/L
Most sensitive freshwater species	*Selenastrum capricornutum*	½ LC_{50} = 1.55 µg/L
Most sensitive estuarine/marine species	Marine mussel (*Mytilus*)	½ LC_{50} = 3.25 µg/L

Model Input Data for Terrestrial Buffer Zones (from 2006 RED)		
Half-life for terrestrial buffer zones	Stable	—
Most sensitive terrestrial plant species	Monocot	EC_{25} = 7640.45 g a.i./ha

Aerial Use Data (from Canadian labels)				
Crop	**Formulation Type**	**Registration No.**	**Number of Applications**	**Rate of Application (g a.i./ha)**
Peppers	Wettable powder	24538	5	1300
Potatoes	Wettable powder	24538	1	700
Potatoes	Wettable powder	24538	1	1360
Tomatoes	Wettable powder	24538	10	900

Product Information for Aerial Use	
Parameter	**Value**
Registration No. 24538	
Aircraft type	Fixed-wing or rotary
ASAE spray quality	Medium
Carrier	Water
Product guarantee	50 g a.i./L
Specific gravity of end-use product	1.141 g/mL
Minimum spray volume	46.8 L/ha
Water content of product	30%
Wind speed	16 km/hr
Temperature	25°C
Relative humidity	50%

Appendix IV Recommended Use Details from Appendix A of 2006 USEPA RED

NOTE: Maximum application rates are in pounds of Cu^{2+} / acre

Crop		Maximum per Application Rate (lbs Cu^{2+}/A)[1]	Maximum Annual Rate (lbs Cu^{2+}/A)[2]	Minimum Retreatment Interval[3]	Notes
Tree Fruit					
Pome Fruit (apple, pear, quince)	Fall, late dormant	8.0	16.0	n/a (only 1 application per season permitted)	Quince use not permitted in California
	Bloom, growing season	0.5		5 days	
Atemoya, Sugar Apple (*Annona*)		3.15	12.6	7 days	Not for use in California
Avocado		3.15	18.9	14 days	—
Banana		1.05	18.9	7 days	—
Carambola		2.1	10.5	7 days	Not for use in California
Citrus (grapefruit, kumquat, lemon, orange, pummelo, tangelo, tangerine, lime)		3.15	12.6	7 days	—
Guava		1.23	4.92	7 days	—
Mamey Sapote		2.1	8.4	14 days	Not for use in California
Mango		2.6	18.2	30 days	Not for use in California
Olive		3.15	6.3	30 days	—
Papaya		2.63	21.2	14 days	Not for use in California
Passion Fruit		2.36	9.44	7 days	Not for use in California
Persimmon		1.0	6.0	14 days	—

Crop		Maximum per Application Rate (lbs Cu^{2+}/A)[1]	Maximum Annual Rate (lbs Cu^{2+}/A)[2]	Minimum Retreatment Interval[3]	Notes
Stone Fruit (peach, plum, nectarine, almond, apricot, cherry, prune)	Dormant, late dormant	8.0	18.0	7 days	—
	Bloom/growing season	1.5		5 days	—
Tree Nuts					
Betel Nut (Guam)		0.75	8.25	7 days	—
Cacao		2.25	15.75	14 days	—
Coffee		2.1	12.6	14 days	—
Filbert		6.0	24.0	14 days	Permitted only in Washington State and Oregon
Litchi		1.23	4.92	7 days	Not for use in California
Tree Fruit					
Macadamia		2.36	9.44	7 days	—
Pecan, Pistachio		2.1	8.4	14 days	—
Walnut		3.15	25.2	7 days	—
Field Crops					
Alfalfa		0.53	1.12	30 days	—
Corn (Field Corn, Popcorn, Sweet Corn)		1.05	4.2	7 days	Not permitted in California
Peanut		0.79	4.74	7 days	—
Potato		2.5	25.0	5 days	—
Soybean		0.79	4.74	7days	—
Sugar Beet		1.31	7.86	10 days	—
Tobacco		2.0	8.0	10 days	—
Wheat, Barley, Oats		0.53	1.06	10 days	—

Crop	Maximum per Application Rate (lbs Cu^{2+}/A)[1]	Maximum Annual Rate (lbs Cu^{2+}/A)[2]	Minimum Retreatment Interval[3]	Notes
Small Fruits				
Brambles (aurora, blackberry, boysen, cascasde, chehalem, logan, marion, raspberry, santiam, thomless evergreen)	2.0	10.0	7 days	—
Blueberry	2.1	8.4	7 days	Not for use in California
Cranberry	2.1	6.3	7 days	—
Currant, Gooseberry	2.5	10.0	10 days	—
Strawberry	1.5 (severe disease) 1.0	8.19	7 days	—
Vegetables				
Bean (Dry, Green)	0.79	4.74	7 days	—
Beet (Table Beet, Beet Greens)	1.31	7.86	10 days	—
Carrot	1.0	5.0	7 days	—
Celery, Celeriac	1.0	5.3	7 days	Not for use on celeriac in California
Crucifers (broccoli, Brussel sprout, cabbage, cauliflower, collard greens, mustard greens, turnip greens)	0.53	2.65	7 days	—
Cucurbits (cantaloupe, casaba, chayote, cucumber, gourd, honeydew, muskmelon, pumpkin, squash, watermelon)	1.05	5.25	5 days	—
Eggplant	0.79	7.9	7 days	—
Lettuce (endive, escarole)	1.0	8.0	5 days	—
Okra	1.05	5.25	5 days	Not for use in California
Onion, Garlic	1.0	6.0	7 days	—
Pea	0.79	3.95	7 days	—
Pepper	0.79	11.85	3 days	—

Crop	Maximum per Application Rate (lbs Cu^{2+}/A)[1]	Maximum Annual Rate (lbs Cu^{2+}/A)[2]	Minimum Retreatment Interval[3]	Notes
Tree Fruit				
Spinach	0.79	3.95	7 days	—
Tomato	0.53	17.4	3 days	—
Watercress	0.53	2.12	7 days	Not for use in California
Vines				
Grape	3.0	20.0	3 days	—
Hops	0.53	2.65	10 days	—
Kiwi	2.1	6.3	30 days	—
Miscellaneous				
Chives	0.53	2.65	7 days	Not for use in California
Dill	0.79	3.95	7 days	Not for use in California
Ginseng	1.05	5.25	7 days	—
Parsley	1.0	2.0	10 days	Not for use in California
Turfgrass	3.0	9.0	10 days	—
Ornamentals				
Lilies, Easter	2.5	75.0	7 days	Maximum pounds of metallic copper which may be applied in a 12 month period. Do not apply any additional copper pesticide to this land for 36 months.
All Other Ornamentals	2.0	20.0	7 days	Application restrictions apply for several ornamentals in California

Crop	Maximum per Application Rate (lbs Cu^{2+}/A)[1]	Maximum Annual Rate (lbs Cu^{2+}/A)[2]	Minimum Retreatment Interval[3]	Notes
Direct Aquatic Rates				
Sewer Line Treatment	0.5	2.0	6 months	No more than two applications per calendar year. Not permitted in the State of Connecticut and California counties
Algae, cyanobacteria, aquatic weeds (Elodea spp., hydrilla, Potamogeton spp., irrigation canal weed, annual naiads)	1 part per million (ppm)	n/a	14 days	No more than ½ of the water body may be treated at one time. If the treated water is to be used as a source of potable water, the metallic copper concentration must not exceed 1 ppm.
Direct Aquatic Rates				
Schistosome-infected freshwater snail control	1.5 ppm	n/a	n/a	No more than two applications per calendar year. In the State of New York, this pesticide is a restricted use pesticide.
Algae control in aquaculture	0.4 ppm	n/a	n/a	—
Tadpole shrimp in rice fields	2.5 ppm	n/a	n/a	—
Leech control	1.5 ppm	n/a	n/a	—

1 Maximum pounds of metallic copper that may be applied to an acre for each application. Product labels must also include application rates described in liquid units or pounds of total product.

2 Maximum amount of metallic copper that may be applied to an acre each growing season. Lower single application rates at higher application frequencies may be used.

3 Minimum number of days between each application.